



## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification <sup>6</sup>:</b> <b>B63H 11/00</b>	<b>A1</b>	<b>(11) International Publication Number:</b> <b>WO 98/07618</b> <b>(43) International Publication Date:</b> 26 February 1998 (26.02.98)
<b>(21) International Application Number:</b> PCT/NO97/00209 <b>(22) International Filing Date:</b> 19 August 1997 (19.08.97) <b>(30) Priority Data:</b> 963452 19 August 1996 (19.08.96) NO <b>(71) Applicant (for all designated States except US):</b> KVÆRNER ASA [NO/NO]; P.O. Box 169, N-1324 Lysaker (NO). <b>(72) Inventor; and</b> <b>(75) Inventor/Applicant (for US only):</b> PAULSEN, Kim [NO/NO]; Bispeveien 37, N-1347 Hosle (NO). <b>(74) Agent:</b> ONSAGERS PATENTKONTOR - DEFENSOR AS; P.O. Box 265 Sentrum, N-0103 Oslo (NO).		<b>(81) Designated States:</b> AL, AM, AT, AU, AZ, BA, BR, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).  <b>Published</b> <i>With international search report.</i> <i>In English translation (filed in Norwegian).</i>
<b>(54) Title:</b> METHOD FOR WATER JET MAINTENANCE AND A WATER JET INCLUDING AN IMPELLER HOUSING  <div data-bbox="406 1113 1266 1407"> </div> <b>(57) Abstract</b> <p>In a method for maintenance of a water jet (1) provided in a ship, wherein a water inlet (2) leads from the sea (18) to a pump housing (3) which contains at least a bearing arrangement (5) and an impeller (6), the pump housing (3) is divided into an upper part (9) and a lower part (10). The pump housing's upper part (9) is lifted away from the lower part (10), thus exposing the bearing arrangement (5) and the impeller (6) and making them accessible for maintenance, and maintenance is then carried out. The bearing arrangement (5) and/or the impeller (6) may be lifted out of the pump housing (3) for execution of the maintenance.</p>		

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**METHOD FOR WATER JET MAINTENANCE AND A WATER JET INCLUDING AN IMPELLER HOUSING**

The invention concerns a method for maintenance of a water jet provided in a ship, wherein a water inlet leads from the sea to a pump housing which contains at least a bearing arrangement and an impeller.

- 5     The invention also concerns a water jet comprising a water inlet which leads from the sea to a pump housing which contains at least a bearing arrangement and an impeller.

10     Water jets are used to a certain extent in the propulsion of ships. A water jet comprises a water inlet which passes water from the ship's underside to a pump which is located in a pump housing and driven by a motor. A water outlet directed backwards from the pump housing produces a backwardly directed water jet which propels the ship forwards.

15     In known water jets the pump housing is normally located in the area of or immediately below the waterline, inside or aft of the ship's stern. The pump housing is connected to a guide apparatus to give the water jet the most favourable velocity and direction with a view to the propulsion, and a steering apparatus located behind the guide apparatus, to steer the ship by altering the direction of the water jet. The water inlet and the motor are provided inside the ship.

20     In known water jets the pump housing is designed in one piece, with a forwardly directed axial opening connected to the water inlet, and a backwardly directed axial opening connected to the guide apparatus. During maintenance of these known water jets the ship has to be placed in dry dock or a slip, and the connection between the pump housing and the water inlet is  
25     loosened, thus enabling the pump housing with the guide apparatus and the steering apparatus to be lifted away from the ship. This is an expensive and time-consuming operation, which restricts the desire to use water jets.

30     In known water jets the power transfer from the motor to the water jet is performed with an approximately horizontal shaft, possibly via a gear. In order to limit the space occupied by the shaft, and to limit oscillation and mounting problems which may arise with a long shaft, it is desirable to place the motor near the impeller, i.e. far back in the ship. The weight of the motor and the water jet strongly influence the position of the ship's centre of

gravity, and in many cases will be critical for the design of the ship's supporting structures in the stern area.

5 The above-mentioned factors associated with the weight of the water jet and the motor become more important as the size of the ship increases, and are consequently another reason for the restrictions on the desire to use water jets.

10 US 3 030 909 describes a water jet where the pump housing with the impeller are located inside the ship, immediately in front of the ship's sternpost. The steering apparatus is located outside the ship, while the guide apparatus is located in an intermediate position. The ship's centre of gravity is thereby located further forward than with those water jets in which the pump housing is located aft of the ship's stern, but the maintenance of this water jet is cumbersome, and will require the use of a slip or dry dock to dismantle the pump housing.

15 The object of the invention is to provide a method for maintenance of a water jet and a water jet which is not encumbered by the above-mentioned disadvantages.

20 This object is achieved according to the invention with a method and a water jet of the type mentioned in the introduction, characterized by the features which are specified in the claims.

25 In a water jet according to the invention the pump housing with an impeller for transfer of kinetic energy to the water are located inside the actual ship. The steering apparatus is located outside the ship as in known water jets, but may be located nearer the ship, since the pump housing with the guide apparatus do not occupy space between the steering apparatus and the ship's stern. As in known water jets the guide apparatus is located between the pump housing and the steering apparatus, and on the basis of practical adaptations to the individual ship design may be located inside the ship, outside the ship or in an intermediate position.

30 According to the invention the pump housing is divided into an upper and a lower part. During maintenance of the water jet according to the invention these two parts are separated, and the upper part is lifted away, thus exposing

mechanical components inside the pump housing and making them accessible for maintenance and possible removal.

In this patent application the pump housing's mechanical components are specified as an impeller and a bearing arrangement. This should not be  
5 perceived as limiting for the invention, since the pump housing naturally comprises far more components, and moreover the content of components will vary between different designs.

Preferred embodiments of the invention are indicated in the sub-claims. A particularly preferred embodiment is obtained when the invention is  
10 employed together with the invention according to the applicant's simultaneously submitted Norwegian patent application 963451, which is referred to here in its entirety. The invention according to Norwegian patent application no. 963451 is described briefly in connection with the description of the specific embodiment.

15 The invention will now be explained in more detail in association with a description of a specific embodiment, and with reference to the drawing, in which:

fig. 1 is a side view of a water jet according to the invention,

fig. 2 illustrates the water jet viewed from above,

20 figs. 3-5 are side views of the water jet, where parts of the pump housing's mechanical components are in the process of being lifted out, and

figs. 6-7 are side views of the water jet, used together with blocking bodies for water inlet and water outlet.

The same reference numbers are used for corresponding parts in all the  
25 figures.

Figs. 1 and 2 illustrate a water jet 1 with a pump housing 3. The water jet 1 is envisaged located in the rear part of a ship, near the ship's stern. A channel-shaped water inlet 2, defined by walls 17, passes water from the sea 18 under the ship to the pump housing 3. The pump housing 3 contains mechanical  
30 components in the form of an impeller 6, see fig. 3, which supplies kinetic energy to the water and forces the water out in a water outlet 13, and a bearing arrangement 5 which forms the impeller's mounting, and which

consists of a bearing housing, a rotating stern tube, a mechanical seal, bearings and other mechanical components. A not shown motor drives the bearing arrangement 5 and the impeller 6 via a substantially horizontal drive shaft 12.

- 5 A guide apparatus 21 is located in the water outlet 13, behind the pump housing 3, to guide the water into a backwardly directed water jet, and a steering apparatus 22 is located behind the guide apparatus 21 to steer the water jet and thus steer the ship. The guide apparatus 21 and the steering apparatus 22 do not form part of the actual invention, and will not be  
10 described in more detail.

According to the invention the pump housing 3 is divided into an upper part 9 and a lower part 10, and the upper part 9 forms a cover for access during maintenance.

- 15 In the embodiment in figures 1 and 2 the upper and lower parts of the pump housing are provided with flanges, 14 and 15 respectively, which are bolted together with bolts 16 in a known per se manner, but this connection between the upper and lower parts of the pump housing may of course be implemented in other ways. The pump housing's upper part 9 and lower part 10 are also connected to the guide apparatus 21, which connections in the  
20 illustrated embodiment are also designed as bolted flanges.

- When carrying out maintenance according to the method according to the invention the connection is loosened between the pump housing's upper part 9 and lower part 10, and between the pump housing's upper part 9 and the guide apparatus 21. The pump housing's upper part 9 is lifted away with a not  
25 shown device, such as a block and tackle. The mechanical components inside the pump housing 3 are thereby exposed for access and maintenance. Fig. 1 shows the pump housing's upper part 9 in two positions, a position where it is connected with the lower part 10 and a position where it is lifted up and away.

- 30 Fig. 1 further illustrates how the pump housing's upper part 9 is designed with radial dividing lines a-b and c-d towards the water outlet 13 and the water inlet 2 respectively, and axial dividing lines b-c towards the pump housing's lower part 10. This is assumed to be the most favourable shape

with regard to dismantling and lifting away the pump housing's upper part 9, but it is clear that other shapes are also possible.

Fig. 3 illustrates a further phase of the maintenance, where a coupling 11, for connection between the impeller 6 and the drive shaft 12, and a flow body 20 are lifted out of the pump housing.

The coupling 11 may be in the form of a spline coupling, and in this case it may be released from the drive shaft 12 and the impeller 6 by axial displacement of the drive shaft and/or the impeller.

Figs. 4 and 5 show the lifting out of the impeller 6 and the bearing arrangement 5 respectively.

When the ship is in the normal position in the water the pump housing 3 will typically be located under or aligned with the surface of the water, with the result that there is water in the pump housing when the water jet is out of operation. In a preferred embodiment of the invention an additional feature of the method is that the part of the ship where the pump housing is located is raised, preferably by ballasting/deballasting of the ship, thus causing the water level in the pump housing to sink.

In a further preferred method the water inlet 2 is also closed, thus preventing sea water from gaining access to the pump housing 3.

Fig. 6 shows how the water inlet 2 can be closed by a blocking body 30, shown here in the form of an elastic bladder, which through a hatch 19 in the walls 17 of the water inlet can be inserted into the water inlet 2 before the pump housing 3 is opened, under the influence of a fluid pressure which is supplied through a hose 37, being extended to press sections of the blocking body 30 against the walls 17 of the water inlet.

In some designs the water outlet 13 will be closed for the inflow of water from the sea outside the ship by having a section of the water outlet located higher than the surface of the water, and in this case a closing of the water outlet is unnecessary. In a further preferred embodiment of the invention, however, the water outlet is also closed, thus preventing sea water from gaining access to the pump housing.

Fig. 7 shows how the water outlet 13 can be closed by a blocking body 31, shown here in the form of a hollow elastic ring, which is located in a section 32 of the water outlet 13 with an annular cross section, defined by a centrally located orifice pin 33 and an orifice ring 34 provided around the circumference, under the influence of a fluid pressure, being extended to press sections of the blocking body 31 against the orifice pin 33 and the orifice ring 34.

In a second embodiment of the water outlet, where the orifice pin is withdrawn, with the result that it does not form a centrally located section in the water outlet, the water outlet can be closed by a ball-shaped blocking body.

Water remaining in the pump housing can be drained away by known means, such as by opening a drain plug 7 in the bottom of the pump housing.

The preferred embodiments with closing of the water inlet and the water outlet are described in more detail in the applicant's simultaneously submitted patent application P96443.

Compared with the known water jets mentioned at the beginning, a much simpler maintenance is obtained with the invention, since the maintenance can be carried out within the ship. The maintenance is not as in the known water jets dependent on the ship being laid up in a slip or a dry dock, and consequently it can be performed independently of where the ship is located. In addition to the fact that the maintenance in itself thereby becomes simpler and more reasonably priced, a reduction is also obtained in maintenance times, thus increasing the ship's availability for use and its earning power.

Since the expenses of laying up a ship in a slip or a dry dock are greater, the larger the size of the ship, the invention results in a greater area of application for the water jet.

The location of the water jet's housing inside the ship, which is made a practical possibility by the invention, is favourable for the dimensioning of the ship's supporting structures, and is another reason why the water jet by means of the invention can have a greater area of application.

In the above the invention has been explained with reference to a specific embodiment. It is obvious, however, that a number of variants, for example



connected with the design of the pump housing's upper and lower parts, and how they are joined together, will be able to be implemented by a person skilled in the art within the framework of the claims.

## PATENT CLAIMS

1. A method for maintenance of a water jet (1) provided in a ship, wherein a water inlet (2) leads from the sea (18) to a pump housing (3) which contains at least a bearing arrangement (5) and an impeller (6),  
5 characterized in that the pump housing (3) is divided into an upper part (9) and a lower part (10), and that the pump housing's upper part (9) is lifted away from the lower part (10), thus exposing the bearing arrangement (5) and the impeller (6) and making them accessible for maintenance, and that maintenance is then carried out.
- 10 2. A method according to claim 1, characterized in that the bearing arrangement (5) and/or the impeller (6) are lifted out of the pump housing (3) before the execution of the maintenance.
3. A method according to claim 1 or 2, characterized in that, the impeller (6) being connected via a coupling (11) to  
15 a drive shaft (12), the coupling (11) is released from the drive shaft (12) and the impeller (6), and lifted out of the pump housing (3) before the impeller (6) is lifted out.
4. A method according to claim 3, characterized in that, the coupling (11) being a spline coupling, the coupling  
20 (11) is released from the drive shaft (12) and the impeller (6) by axial displacement of the drive shaft and/or the impeller.
5. A method according to one of the preceding claims, characterized in that, due to the fact that when the ship is in a normal position in the water (18) the pump housing (3) is located under or aligned  
25 with the surface of the water, with the result that there is water in the pump housing (3) when the water jet (1) is out of operation, the method has an additional feature that the part of the ship where the pump housing (3) is located is raised, preferably by ballasting/deballasting of the ship, thus causing the water level in the pump housing (3) to sink.
- 30 6. A method according to one of the preceding claims, characterized in that the method also comprises the closing of the water inlet (2), preferably by placing a blocking body (30), especially an inflatable body,

in the water inlet (2), thus preventing sea water from gaining access to the pump housing (3), and possibly draining away water which is located in the pump housing by opening a drain plug (7) in the bottom of the pump housing.

- 5        7.     A method according to one of the preceding claims, characterized in that, the pump housing (3) also being connected to a water outlet (13), the method also comprises the closing of the water outlet (13), preferably by placing a blocking body (31), especially an inflatable body, in the water outlet.
- 10      8.     A water jet (1) comprising a water inlet (2) which leads from the sea (18) to a pump housing (3) which contains at least a bearing arrangement (5) and an impeller (6), characterized in that the pump housing is divided and comprises an upper part (9) and a lower part (10).
- 15      9.     A water jet (1) according to claim 8, characterized in that the pump housing's upper part (9) forms a cover for access during maintenance.
- 20      10.    A water jet (1) according to claim 8 or 9, characterized in that the pump housing's upper part (9) and lower part (10) are connected by bolted flanges (14,15).

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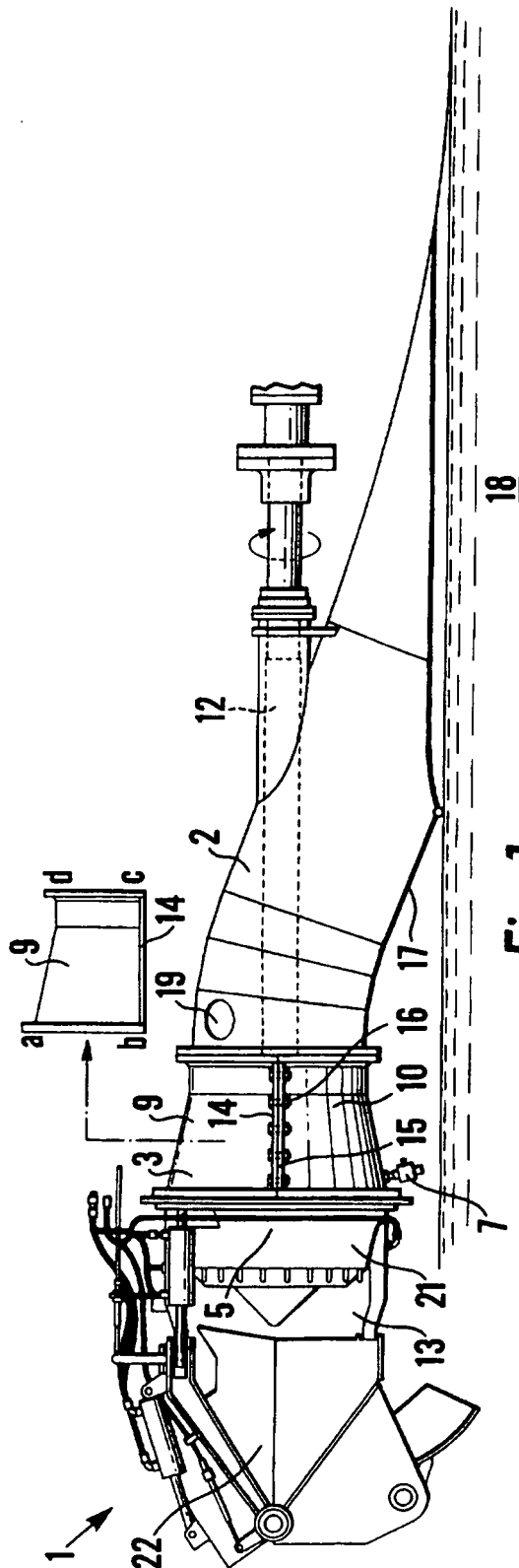


Fig. 1

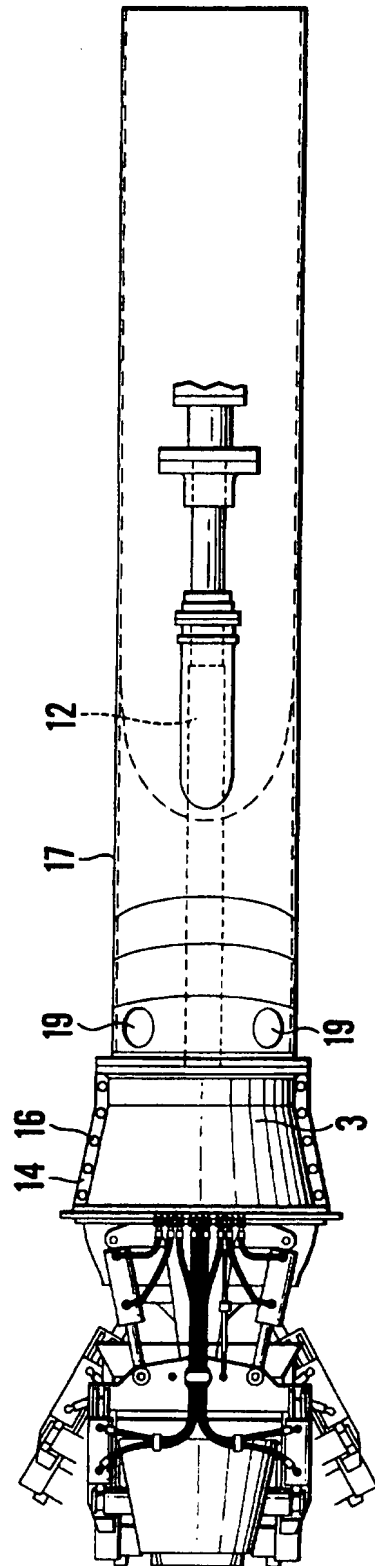


Fig. 2

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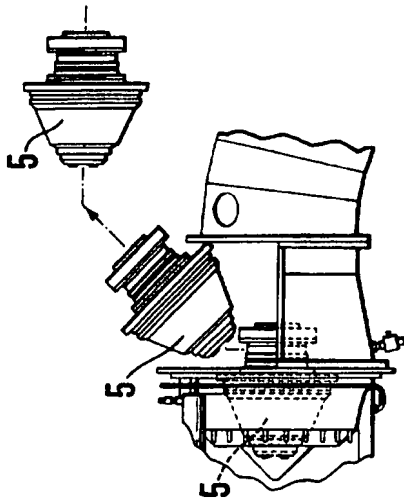


Fig. 5

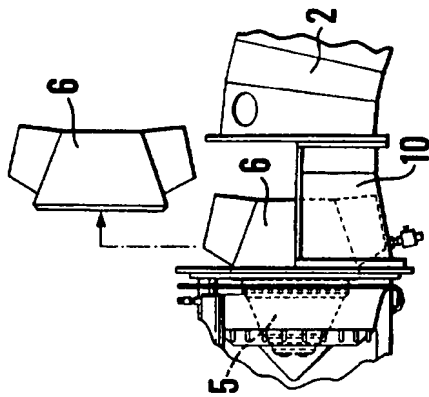


Fig. 4

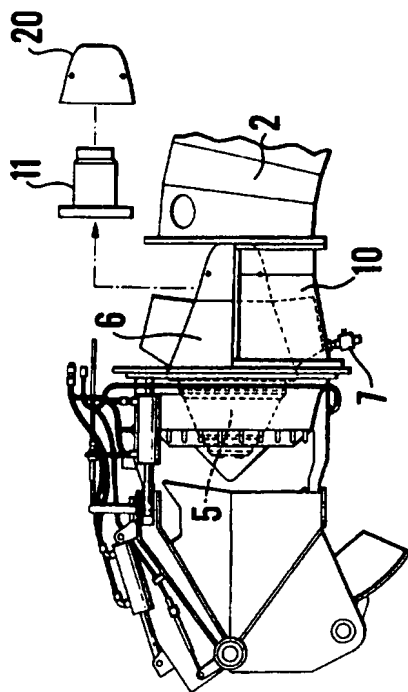


Fig. 3

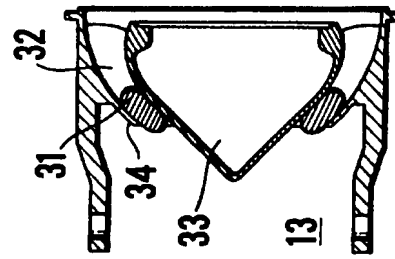


Fig. 7

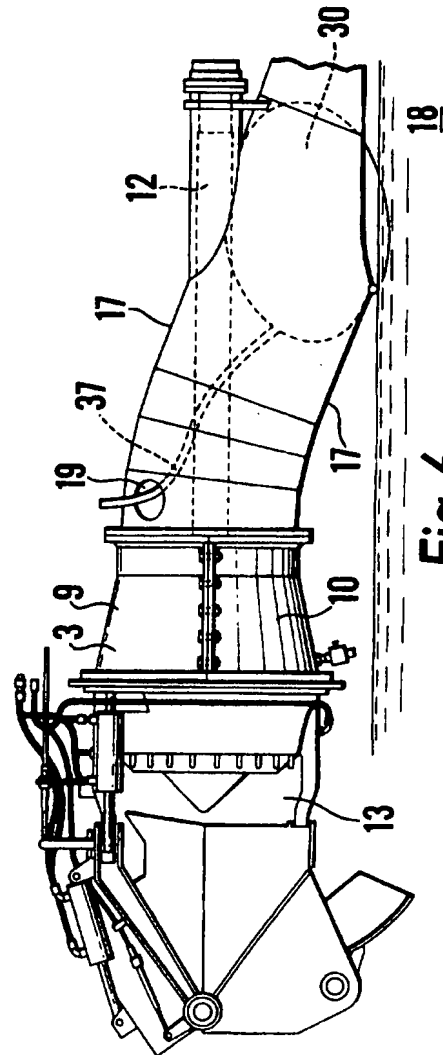


Fig. 6

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/NO 97/00209

## A. CLASSIFICATION OF SUBJECT MATTER

IPC6: B63H 11/00  
According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: B63H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4004541 A (ONAL), 25 January 1977 (25.01.77), column 2, line 45 - line 50, figures 1-6	1-5,8-10
Y	--	6,7
Y	DE 86469 A5 (MAX BUSSE), 28 April 1896 (28.04.96), page 1, column 2, line 5 - line 6, figures 3,4	6
Y	WO 8805008 A1 (KAMEWA AB), 14 July 1988 (14.07.88), page 4, line 13 - line 16, figure 1	7
A	US 5123867 A (BROINOWSKI), 23 June 1992 (23.06.92), column 7, line 28 - line 42, figures 1-4	1-10

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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Date of the actual completion of the international search

21 November 1997

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Intern. application No.  
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